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COMMUNICATION PROCESS BY ANTENNA FOR SMART CARD AND ASSOCIATED EQUIPMENT

DESCRIPTION

The invention relates to smart cards, and particularly communication processes between a smart card and an external unit.

Smart cards are becoming a widely used support to contain and transfer different types of information, particularly for bank transactions, transport tickets, health information and for identification. Smart cards are usually stored in a plastic card, like a bank card. These cards usually contain a memory and a processor intended for storage and processing of data. The smart card is conventionally inserted into a card reader that makes an electrical contact with electrical contacts of the card.

ISO standard 7816 defines the characteristics of the most widely used smart cards. This standard is thus used to define the characteristics of SIM cards or bank cards. ISO standard 7816-2 defines the number, function and position of electrical contactS on the surface of the chip with a connected interface. The English version of ISO standard 7816-2 calls these contacts "pins". Surface pins are denoted C1 to C8 in this standard. Pin C1, also denoted Vcc, is used to make a power connection through which the chip on the card is supplied with power. Pin C2, also referred to as RST or Reset, transmits an external command signal initiating a chip reinitialisation instruction sequence. Pin C3, also denoted CLK, transmits a clock signal to the chip. Pin C5, also denoted GND, provides an electrical ground common to the integrated circuit of the chip and the device connected to the chip. Pin C6, also called Vpp, is used to program an EEPROM on the chip if there is one. Pin C7, also called the I/O pin, provides a communication channel between the connected device and the chip. ISO standard 7816-2 has not yet assigned any use to pins C4 and C8.

ISO standards 14443 and 15693 propose to include a passive antenna in the card so as to communicate with an external device by radio frequency.

ISO standard 14443 in particular defines a radio-frequency communication protocol that ideally can communicate at up to 20 centimetres from the antenna. However the communication distance provided by the antenna is limited. The communication speed is also limited by the modulation frequency.

ISO standard 15693 describes another communication protocol to communicate at a greater distance than with ISO standard 14443, but with a lower communication speed. The communication distance supplied is still relatively small.

In general, antennas of these smart cards have a limited range. Furthermore, their range is strongly affected by their environment. In general, the presence of metallic parts (particularly a battery or other electrical circuits of a device in which the card is placed) deteriorate the range of the card. Furthermore, some small cards (for example a SIM card) cause lower antenna performances.

Therefore there is a need for a communication process, a smart card and equipment solving one or several of these problems, and the invention is intended to satisfy this need.

The process according to the invention, complying with the generic definition given in the above preamble, is essentially characterised in that it comprises the following steps:

- supply of equipment fitted with at least one antenna and at least two pins connected to the antenna;
- supply of a smart card with a chip supplied with:
  - at least two surface pins;
  - a processing module;
  - a radio-frequency interface associated with the processing module and connected to the surface pins of the card, the surface pins of the card being coupled to the pins of the equipment;
- transmission of electrical signals between the surface pins of the card and the antenna.

According to one variant, the supplied chip is in the format given in ISO standard 7816-2 and the surface pins of the card are pins C4 and C8.

The invention also relates to a smart card with a chip fitted with at least two surface pins and a processing module, also comprising a radio-frequency interface associated with the processing module and connected to the two surface pins.

According to one variant, the chip is in the ISO standard 7816-2 format and the surface pins of the card are pins C4 and C8.

According to yet another variant, the card is in the format defined in ISO standard 7816-1.

According to another variant, the card is in the format of a GSM standard.

The invention also relates to equipment with an antenna and a coupling interface that could be coupled to a smart card, in which:

- the coupling interface has two pins that could be coupled to surface pins of a so-called smart card;
- the pins of the equipment are connected to the antenna.

According to one variant, the equipment pins can be coupled to pins C4 and C8 of a smart card in the ISO standard 7816-2 format.

According to another variant, the equipment is a cell phone.

According to another variant, the telephone has a body and a removable battery and the antenna is fixed to the removable battery.

According to another variant, the telephone has a body and a removable battery and the antenna is fixed to the body.

The equipment according to the invention can also be an automobile vehicle, a PDA, a smart card support or a storage device.

According to one variant of such an equipment, the antenna is active.

The invention will be better understood after reading the following description and an examination of the Figures that accompany it. The Figures show:

- Figure 1, a diagrammatic view of the geometry of a SIM card;
- Figure 2, a block diagram of a first variant of a chip according to the invention;

- Figure 3, a block diagram of a second variant of a chip according to the invention;
- Figure 4, a diagrammatic view of a cell phone according to the invention.

The invention proposes to communicate with a smart card by coupling surface pins of the card with an antenna on a connected device. The smart card can then use the antenna of the connected device for contactless communication with other equipment. When the surface pins of the smart card are coupled to pins of the equipment connected to the antenna, electrical signals are emitted between the surface pins and the antenna.

Figure 1 diagrammatically shows the geometry of a SIM card in the format of a GSM standard. The SIM card is a particular example of a smart card, in which the card is in the format defined in the ISO generic standard 7816-1, and in which the chip is in the format defined in the ISO generic standard 7816-2. The card 1 has a contact interface 2 made on a card body 3. The contact interface 2 has surface pins C1 to C8 as defined in ISO standard 7816-2.

In the variants of chips 21 shown in Figures 2 and 3, a radio-frequency interface 22 is associated with a processing module 25. A processing module associated with a radio-frequency interface will cover both:

- the alternative in which the radio-frequency interface 22 is a module independent of the processing module, connected to the processing module 25, and
- the alternative in which the processing module 25 integrates the radio-frequency interface 22.

Figure 2 shows a block diagram of the first alternative structure of the chip 21 placed in a card 1 according to the invention. The chip 21 comprises a processing module 25 connected to a radio-frequency interface 22 through an appropriate type of connection or link 23.

Figure 3 shows a block diagram of the second alternative structure of a chip 21. In this alternative, the radio-frequency interface 22 is integrated into the processing module 25.

Using these variants, the processing module 25 is designed particularly to perform various typical logical functions of a smart card. In particular, an appropriate micro controller can be used as a processing module 25. The processing module 25 is for example connected to surface pins C1 to C3 and C5 to C7, in a manner known in itself. The radio-frequency interface 22 is connected to the surface pins C4 and C8. The radio-frequency interface 22 is designed to process or generate electrical signals at appropriate frequencies.

The chip 21 of the card 1 can thus generate radio-frequency electrical signals through the radio-frequency interface 22. As will be described in detail later, this structure enables the chip 21, and particularly the processing module 25, to use the antenna of an associated equipment to communicate by radio frequency. Therefore, the communication range of the smart card 1 is not limited by the dimensions of this card. Thus, a particular smart card, even the size of a SIM card according to the format of a GSM standard, can be used in many applications requiring significantly different communication ranges. The possible use of surface pins C4 and C8 according to ISO standard 7816-2 for the transmission of electrical signals with the outside would also be easy to implement since these pins already exist and are not assigned in this standard on the date that this application was submitted.

The radio-frequency interface 22 is designed to process or generate appropriate electrical signals for data communication between the chip 1 and outside equipment.

In the examples in Figures 2 and 3, the chip 21 has one or several memories 24. For example, these memories 24 are integrated into the processing module 25 of the chip 21. These memories 24 are designed to store different items of useful information. In particular, one or several memories 24 chosen from among ROM, RAM read access memories, flash memories, electrically erasable and programmable memories EEPROM, or any other type of appropriate onboard memory, can be used.

Although not described in detail, it is quite clear that the smart card can also include its own antenna in a manner known in itself, so that it can

communicate with the outside without requiring the presence of an item of equipment providing it with an antenna.

We will now describe operation of equipment cooperating with the smart card, for which an example is given in Figure 4. The specific nature of equipment according to the invention is that it has a contact interface with two pins that can be coupled to surface contacts of a smart card 1 described above. The two pins of the equipment are connected to an antenna. This type of equipment enables the smart card 1 to use the antenna 11 through coupling of pins on the equipment and the card. This type of equipment can then increase the communication range of the smart card 1.

Figure 4 shows a cell phone 4 designed to operate with a smart card 1 described above. A cell phone refers to any equipment that can perform the portable telephony function; therefore this term includes PDA (Personal Data Assistants), provided with a GSM function and any other similar equipment. The telephone 4 has a telephone body 5, a GSM communication antenna 6 and power supply contacts 7 to 10 designed to be coupled to a removable battery not shown, in a manner known in itself. The body 5 also includes a housing 12 in which a smart card with a given format can be fitted. A coupling interface including pins A1 to A8 is arranged for example in the bottom of the housing 12. Pins A1 to A8 are arranged so that they can be coupled by electrical contact to the surface pins C1 to C8 respectively, on a smart card 1 inserted in the housing 12. For the reasons mentioned above, an equipment connection interface according to ISO standard 7816-2 will be used in preference.

Pins A4 and A8 on the equipment have a connection to an antenna 11. The antenna may be adapted to communicate in the predefined frequency bands, such as the carrier frequency bands specified in ISO standard 14443, standard 15693 or standard 18000. This antenna thus forms a resonant circuit with one or several chosen frequencies. The antenna 11 shown is made in the form of a track printed on a support but any type of appropriate antenna could also be envisaged. The antenna could also be provided with passive or active electronic components,

in particular to make impedance matching. An amplifier could also be arranged on the connection of the antenna to the equipment pins.

In the variant of the telephone 4 shown, the antenna 11 is fixed to the telephone body 5. For example, the antenna 11 may be placed on a position providing it with optimum range, that can be determined by those skilled in the art.

The antenna 11 can also be implanted on a removable battery of the cell phone. This arrangement would enable a user to replace a battery to connect the smart card 1 to the antenna 11 of the telephone, keeping its original telephone. In particular, it would be possible to add or assign electrical pins on the phone to supply a connection to a smart card placed in the body, with an antenna 11 placed in the battery. It would also be possible to implant a coupling interface to a smart card on a battery and an antenna connected to the pins of this interface.

It would also be possible to envisage other types of equipment such as vehicles, cases or supports for smart cards, portable listening equipment or storage devices such as containers or cardboard boxes. In particular, an automobile vehicle can be envisaged fitted with an antenna connected to a smart card coupling interface located inside the passenger compartment. For example, the antenna could be adapted to communicate with a toll, to make a remote toll application. In particular, a subscription recorded on the card could be detected, or a debit could be recorded on an account associated with the smart card. It would also be possible to envisage card cases or supports fitted with an antenna connected to a smart card coupling interface. Equipment provided with such a coupling interface could also include an active antenna, so as to increase the communication range of the smart card.

The corresponding impedances of the antenna of the equipment and the surface pins C4 to C8 of the smart card are adapted to have a resonant frequency chosen for the modulation frequency band chosen.

The communication process associated with such a smart card and such equipment includes the following steps:

- during a connection step:

- equipment is supplied fitted with an antenna and at least two pins connected to the antenna;
- a smart card is provided with a chip fitted with at least two surface pins, a processing module and a radio-frequency interface associated with the processing module and connected to the surface pins of the card, the surface pins of the card being coupled to the pins of the equipment;
- electrical signals are transmitted between the card pins and the antenna in a subsequent transmission step.